ARENARIA GRŒNLANDICA NEAR MIDDLETOWN, CONN.—I would also report *Arenaria grœnlandica* Spring., as occurring in this vicinity. I have observed it in two places, both summits of rocks. It appears to grow in the very shallow bed of soil that collects on exposed rocky knobs, and is very abundant in these two narrow limits. The flowers are larger and the plants more luxuriant than in specimens from Greenland that I have seen, yet its identity is undoubted, and on the authority of Professors Gray and Eaton. The rocks on which it is found, occur on hills that rise two hundred feet or thereabouts, above the general level of the surrounding country.—*Henry L. Osborn, Wesleyan University.*

BOTANICAL NOTES.—In the *Botanical Gazette*, for April, Mr. I. C. Martindale discusses the germination and growth of the parasite, *Orabanche ramosa*, and M. E. Jones records his observations on remarkable forms of *Triticum repens.*——*Grevillea* for March notices New York fungi.——According to Prillieux, the roots of *Hartwegia ramosa* are negatively heliotropic, lengthening both by day and by night, due as he thinks, to the increased amount of growth on the illuminated sides. We also learn from the *Journal* of the Royal Microscopical Society for April, that a luminous fungus has been reported from the Andaman Islands; it is an agaric of small size, but exceeding in brilliancy anything which has hitherto been observed.——The influence of light on the movements of Desmids, has been investigated by E. Stahl, who finds that the cell of Closterium shows a tendency to place its longer axis in the direction of the rays of light, and that there is also a polarity between the two halves of the cell, in consequence of which, one is attracted towards, and the other driven away from the source of light. There is also a slow movement of the individual along the bottom in the direction of the source of light. When the light is very intense, the conditions are reversed, and the cell places itself with its longer axis at right-angles to the direction of the light. Observations by Göbel on Micrasterias and on the influence of light on the spores of low plants are noticed.——Ferdinand Lindheimer, the collector of "Plantæ Lindheimerianæ," lately died at New Braunfels, Mexico, aged about 78.——In a pamphlet printed at Camden, N. J., and entitled "Notes on the Bartram Oak, *Quercus heterophyela* Michx.," Mr. I. C. Martindale enters into an elaborate discussion of the reasons why the foregoing name given by Michaux should be maintained, and its rank as a good species established. The immediate occasion for the essay, was the discovery of some trees near Mount Holly.

ZOÖLOGY.[1]

THE ISLAND OF REIL.—Dr. Spitzka has advanced reasons for denying the current theory that the Island of Reil is the locality

[1] The departments of Ornithology and Mammalogy are conducted by Dr. ELLIOTT COUES, U. S. A.

of the function of speech. He find it to be very large in the hippopotamus, relatively three times as large as in the horse, while it is very much reduced in the seal. On the other hand, in the porpoise it is relatively larger and considerably more convoluted than in man. It differs from that of man in being highest behind and tapering forwards; in man it is higher in front and tapers backwards.

ON THE INTERNAL STRUCTURE OF THE BRAIN OF LIMULUS POLYPHEMUS.[1]—Several years ago I attempted to study the brain of the horse shoe crab (*Limulus polyphemus)*, and had it sliced into a large number of sections. Owing to interruptions these sections, made from unstained alcoholic specimens, were not examined: during the past winter I have been able with the aid of Mr. N. N. Mason, of Providence, to take up the study afresh. Mr. Mason has kindly made sections, both transverse and horizontal, stained with osmic acid; also sections of the brain of the supra-œsophageal ganglion of the lobster, stained with picro-carmine, for comparison. The following results, then, are based on over two hundred sections of the supra-œsophageal ganglion of Limulus, but more especially on one brain, which was cut by Mr. Mason into fifty-six sections, from $\frac{1}{1000}$ to $\frac{1}{500}$ of an inch in thickness, and another cut into over forty. The examination of a few sections of the lobster's brain, enabled me to comprehend more readily the recent papers of Dietl, Newton and Krieger on the brain of the Decapodous Crustacea and of the insects, and thus give me a standard of comparison by which to study the topography and histology of the brain of Limulus.

General Anatomy of the Brain.—The singular relations of the central nervous system of the adult Limulus, have been fully described and beautifully illustrated by A. Milne Edwards, and Dr. Dohrn and myself have described its general anatomy in the larval stage. The central nervous system of Limulus consists of an œsophageal collar, mostly made up of six pairs of ganglia, from which nerves are distributed to the six pairs of foot-jaws (gnathopods), while the ring is closed or completed in front by the brain, or what corresponds to the supra-œsophageal ganglion of normal Crustacea and insects. In these Arthropoda, the brain is situated in the upper part of the head in a plane parallel to but quite removed from that of the rest of the ganglionic chain; in Limulus, however, the brain is situated directly in front of and on the same plane with the rest of the central nervous system. Milne Edwards states that the œsophageal ring, as well as the posterior part of the nervous system, is enveloped by an arterial coat; he also states that the brain and nerves are enveloped in a similar arterial coat, but this we have failed to find; the brain is protected by a thick membrane ("perineurium" of Krieger) formed of fibrous connective tissue, and the nerves are protected

[1]Read at the meeting of the National Academy of Sciences, held at Washington, April 21, 1880.

by a continuation of this membrane, as several longitudinal sections of these nerves have taught us. The brain in a Limulus ten inches long, exclusive of the caudal spine, is about five or six millimetres in diameter; it is flattened slightly above, and on the upper side has a shallow median furrow, indicating that it is a double ganglion. Three pairs of nerves and a median unpaired one (the ocellar), arise from the upper third of the anterior face of the brain. The two optic nerves are the largest ones, arising one on each side of the median furrow, so that the fifth to fifteenth sections made by the microtome, pass through them. Next below (from above downwards) is the origin of the ocellar nerve, which, as described by A. Milne Edwards, is single, arising from the median line; on each side and in nearly the same plane, arise two tegumental nerves, and directly below a second pair of larger nerves (fronto-inferior tegumental) descend vertically. No nerves arise from the lower half or two-thirds of the brain, which is smooth and rounded, with no median furrow underneath. It will thus be seen, that, as stated by A. Milne Edwards, there are no antennal nerves, such as exist as a rule in Arthropods except Arachnida. This we have proved in the same manner as Milne Edwards, by laying open the arterial coat or modified neurilemma, which reaches to the posterior end of the brain, and seeing that the fibres of the nerves sent to the first pair of legs originate quite independently of the brain itself.

Internal Structure and Histology of the Brain.—Transverse sections of the brain throw but little light on the topography, as the nerve fibres extend horizontally, the nerves being sent out horizontally and from the anterior end only of the brain; hence the examination of nearly two hundred sections threw little light on the topography, and considerable time was spent in a vain and baffling attempt at understanding the geography of this ganglion.

The study of two brains each sliced horizontally into about fifty sections, carefully mounted by Mr. Mason in consecutive order, finally enabled me to arrive at a tolerably complete idea of the relations of parts, so that I could mentally construct a model of the brain of Limulus, and compare it with the normal Arthropod brain.

The histological elements of the brain of Limulus are three in number. 1. Large ganglion cells, filled densely with granules and with a well-defined nucleus similarly filled and with a granular nucleolus. These cells may be crowded or loose, with the granules fewer in number, and with loose, thick cell-walls; they terminate in large fibres which sub-divide. 2. Similar cells, but smaller with less protoplasm, and like those in the lobster's brain. 3. Nerve fibres; these, like the large sized ganglion cells, from which they originate, are stained tawny yellowish-brown with osmic acid. These fibres are large, coarse, their granular contents very homogeneous, and they closely resemble the nerve fibres distributed to the compound and simple eyes. Certain fibres near the origin of the optic nerves, are distinctly nucleated

at intervals. 4. Rounded masses, consisting wholly of nuclei, enclosed in a network of fibres, which stain dark brown with osmic acid; these bodies form the larger part of the substance of the brain, while staining dark brown with osmic acid; in unstained alcoholic sections these masses are dark or grayish, the substance or fibres enclosing them, being whitish, by transmitted light. The brain is enveloped by a thick perineurium, formed of a fibrous tissue, and some (probably) elastic tissue, which occasionally penetrates into the brain-substance between the white rounded fungoid masses, forming the mesh-work surrounding them. The general topography of the brain of Limulus is on a simple plan compared with that of Decapodous Crustacea and insects. The brain is mostly composed of large irregular rounded masses or balls of nuclei, with a thick fungoid or ruffle-like periphery, formed by a layer of secondary smaller rounded granular masses. The center of the primary masses is stained paler brown by osmic acid. These masses are often seen in section, rounded, but more often are irregular, not closed spheroids; these fungoid or nucleogenous bodies extend through the brain like ruffles. The lower half or two-thirds of the entire brain is apparently filled with these nucleogenous bodies, as we may provisionally designate them. In the upper third of the brain, whence the nerves originate, the larger ganglionic cells and the nerve fibres appear, and preserve a definite topographical relation to the entire brain. The nucleogenous bodies are confined at the top to each side of the brain; the central and hinder regions are filled with the large ganglionic cells, mixed with numerous much smaller ones, and the mass of nerve fibres which spring from them, becomes larger from the upper third to the top of the brain where the optic fibres originate. Opposite the beginning of the optic nerves, these large nerve fibres are seen directed towards the origin of the nerves as if they were the roots, as they undoubtedly are. In the section passing through the ocellar nerve and the tegumentary nerves on each side, the fungoid masses are situated in the front of the brain; but they disappear from the front higher up at the origin of the optic nerves, and occupy a much more restricted area on the sides of the brain. Thus the tract of nerve fibres on either side of the brain is irregularly wedge-shaped, the apex situated near the centre of each hemisphere, and the base spreading out on the top, thus crowding to the outer walls the nucleogenous bodies.

It would thus appear as if the lower half of the brain were in an indifferent state,[1] and that the dynamic part were confined to the upper third, the region giving origin to the nerves of sensation.

[1] This area, made up of granules and nuclei, seems really to be connective tissue, and to represent the connective tissue in which the ganglia of the embryo of the young larva are embedded. There seems no reason why the brain should not be partly formed from connective tissue as much as the remaining ganglia, as we have seen them to be in different sections of different ganglia, all or nearly all except the supra-œsophageal one.

The asymmetry of the brain is remarkable ; the large ganglionic cells are most abundant in the center behind the middle and from there to the posterior side of the brain ; a median line is slightly indicated by the arrangement of the fungoid masses. The tract composed of large nerve fibres with scattered ganglionic cells on the left side is very much more extensive than on the right.

Comparison with the brain of other Arthropods.—So wholly unlike in its form, the want of antennal nerves, and internal structure, is the supra-œsophageal ganglion, or "brain," of Limulus to that of insects and the higher Crustacea, that it is very difficult to find any points of comparison.

Histologically, judging by my specimens of the brain of the lobster which are stained with carmine, the brain of Limulus agrees with that of other Arthropods in having similar large ganglion-cells ; the smaller ganglion-cells, so abundant in the brains of insects and Crustacea, are wanting in Limulus. There are, in Limulus, no *ballen-substanz*-masses homologous with those of the other Arthropods nor any "mush-room" bodies.

Topographically the internal structure of the brain of Limulus is constructed on a wholly different type from that of any other Arthropodous type known, so much so that it seems useless to attempt to homologize the different regions in the two types of brain. The plan is simple in Limulus ; much more complex in Arthropods, especially in the brain of the craw-fish, as worked out by Krieger, as in the Decapodous brain there arise two pairs of antennal nerves besides the optic pair, and in external form the two types of brain are entirely unlike. The symmetry of the brain of the crayfish, as of the lobster and insects, is marked throughout, each hemisphere exactly repeating in its internal topography, the structure of the opposite side ; the symmetry of that of Limulus is obscure and imperfect.

THE FOOD OF BIRDS.—Under this title Prof. S. A. Forbes has published in the Transactions of the Illinois State Horticultural Society, a valuable report on the food of the thrushes. In Illinois there are estimated to be three birds to an acre during the six summer months. We make the following extracts : "It is my own opinion that at least two-thirds of the food of birds consists of insects, and that this insect food will average, at the lowest reasonable estimate, twenty insects or insects' eggs per day for each individual of these two-thirds, giving a total for the year, 7200 per acre, or 250,000,000,000 for the State—a number which, placed one to each square inch of surface, would cover an area of 40,000 acres.

"Careful estimates of the average number of insects per square yard in this State, give us at farthest 10,000 per acre for our whole area. On this basis, if the operations of the birds were to be suspended, the rate of increase of these insect hosts would be accelerated about seventy per cent., and their numbers, instead of

remaining year by year at the present average figure, would be increased over two-thirds each year. Any one familiar with geometrical ratios will understand the inevitable result. In the second year we should find these pests nearly three times as numerous as now, and with that astounding acceleration of increase characteristic of geometrical progression, they would multiply until in about twelve years we should have the entire State carpeted with insects, one to the square inch over our whole territory. I have so arranged this computation as to exclude the insoluble question of the relative value of birds and predaceous or parasitic insects, unless we suppose that birds eat an undue *proportion* of beneficial species.

"Take another view of this matter. According to the computation of Mr. Walsh, the average damage done by insects in Illinois amounts to twenty millions dollars a year. Large figures certainly; but when we find that this means only about fifty-six cents an acre, we begin to see their probability. Few intelligent farmers or gardeners would refuse an offer to insure complete protection, year after year, against insects of all sorts, for twenty-five cents an acre per annum, and we will, therefore, place the damage at one-half the above amount—ten million dollars per annum.

"Suppose that, as a consequence of this investigation, we are able to take measures which shall result in the increase, by so much as one per cent. of the efficacy of birds as an insect-police, the effect would be a diminution of the above injury to the amount of sixty-six thousand dollars per annum, equivalent to the addition of over one and a-half million dollars to the permanent value of our property; or if, as is in fact a most moderate estimate, we should succeed in increasing the efficiency of birds five per cent., we should thereby add eight and one-fourth millions dollars to the permanent wealth of the State, provided, as before, that birds do not eat unduly of beneficial species.

"These figures will be at once rejected by most naturalists as absurdly low. The young robin of Prof. Treadwell (a bird whose fame has extended over both hemispheres) required not less than sixty earth-worms a day, equivalent to at least two hundred and fifty average insects, to keep it alive. A pair of European jays have been found, Dr. Brewer informs us, to feed their brood half a million caterpillars in a season, and to eat a million of the eggs in the winter.[1]

"Compared with these numbers, my 7500 insects a year seem certainly many times too few, and similar criticisms might very probably be made on other items of the estimate. I prefer, however, to put these matters with a moderation which will command

[1] A young mocking-bird (*Mimus polyglottus*), raised from the nest by my nephew, Robert Forbes, ate about 240 red-legged grasshoppers daily, equivalent to at least 480 average insects.

general assent, especially as we see that the importance of the subject does not require exaggeration. Of course the individual farmer or gardener could, by intelligent and careful management, if he knew just what to do, increase the value of his own birds far beyond his individual share of the above-mentioned general aggregate.

"It is thus made probable that the birds intervene continuously between us and the complete destruction of our most important industries, the irretrievable financial ruin of nearly our whole population."

In conclusion, Mr. Forbes does not, with his present knowledge of economical entomology, attach any great economical value to the thrush family; it appears from his paper that they often eat many insects beneficial to agriculture, particularly ground beetles, still he would treat this question with careful conservatism, and not turn the delicate balance of nature by the extermination or undue breeding of birds.

ZOÖLOGICAL NOTES.—The study of the Siphonophores is advanced by two excellent papers by Mr. W. J. Fewkes, in the Proceedings of the Boston Society of Natural History, one on the structure of *Rhizophysa filiformis*, and the other on the tubes in the larger nectocalyx of *Abyla pentagona*, both Mediterranean forms. Mr. Tewkes has added three Siphonophores to our New England fauna.——To the same number of the Proceedings, Dr. W. K. Brooks contributes a paper on the development of the digestive tract in Mollusks.——Dr. Fritz Müller has discovered a minute Ostracod Crustacean, like Cythere, living in the tree tops of the Bromeliaceæ in Southern Brazil. It appears that these tree tops harbor a host of animals, including the larvæ of insects, even the tadpoles of treefrogs here undergoing their transformations.——The process of respiration in some Crustacea, as Astacus, certain Phyllapoda and Cladocera, has been shown to be in part carried on in the anus; in Leptodora, as shown by Weismann, this is the exclusive mode of respirations. Mr. Hartog now shows (in the *Quarterly Journal of Microscopical Science* for April) that it occurs in several Copepod Crustacea. He also describes how the Hydra swallows its prey. The part played by the tentacles ceases as soon as the mouth comes in contact with the food. The hydra then slowly stretches itself over the food and engulfs it, the tentacles usually turning away from the food.

ANTHROPOLOGY.[1]

A DICTIONARY AND GRAMMAR OF THE AIMARÁ LANGUAGE.—The literature of aboriginal languages has just been favored with an important addition in the shape of a "Dictionary and Grammar of the Aimará language," spoken in the southern portion of Peru, by the Collas (pron. Cólyas) and other tribes. This language is

[1]Edited by Prof. OTIS T. MASON, Columbian College, Washington, D. C.